Uncommon forms of AV reentry: atrio and fasciculó-ventricular fibers, slow conducting fibers

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Common forms of AV reentry

- Accessory pathways:
  - Upper insertion: atrium
  - Lower insertion: ventricle
  - Conduction time: short and fixed

- AV nodal reentry:
  - Up the fast, down the slow pathway
Uncommon forms of AV reentry

- Accessory pathways:
  - Upper insertion: AV node
  - Lower insertion: right bundle (fascicle)
  - Conduction time: long and/or decremental
- AV nodal reentry:
  - Up the slow, down the fast pathway
Uncommon forms of AV reentry in real life

- **Accessory pathways:**
  - Antegrade conducting (“antegrade only”):
    - Atrio-fascicular
    - Atrio-ventricular with long conduction time
    - Nodo-fascicular
    - Nodo-ventricular
    - Fasciculo-ventricular: no reentry
  - Retrogradely conducting (concealed):
    - Atrio-ventricular with long conduction time

- **AV nodal reentry:**
  - Up the slow, down the fast pathway
Uncommon forms of AV reentry in real life

- Accessory pathways:
  - Antegrade only:
    - Atrio-fascicular
    - Atrio-ventricular with long conduction time
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Schematic representation of uncommon AP

Atrio-ventricular (short)
Atrio-ventricular (long)
Atrio-fascicular

AVN
His
LBB
RBB

Nodo-fascicular

Nodo-ventricular

Fasciculo-ventricular
Uncommon forms of AV reentry in real life

- Accessory pathways:
  - Antegradeley conducting ("antegrade only"):
    - Atrio-fascicular: +++
    - Atrio-ventricular with long conduction time: +++
    - Nodo-fascicular: +
    - Nodo-ventricular: +
    - Fasciculo-ventricular: no reentry: ++
  - Retrogradely conducting (concealed):
    - Atrio-ventricular with long conduction time: ++++

- AV nodal reentry:
  - Up the slow, down the fast pathway: ++++
Atrio-fascicular and atrio-ventricular AP with long conduction time: common features

- Right sided: atrial insertion in lateral tricuspid annulus
- Distal insertion: RB (fascicular) or RV (ventricular)
- Antegrade decremental conduction
- No retrograde conduction
- Frequent association with dual AVN pathways

Consequences:
- No or modest degree of preexcitation in SR
- Preexcitation appears with atrial pacing / extrastimuli
- Degree of preexcitation depends on site of A pacing
- HV interval with preexcitation depends on site of distal insertion: if RB: HV≈0; if RV: HV≈-50; if RBBB: HV≈-100
- Antidromic tachycardias: LBBB QRS: DD w AVN reentry

www.escardio.org/EHRA
Conduction through A-fascicular A-ventricular AP with long conduction time

SR – A pacing

Antidromic tach
Baseline ECG

Tachycardia: CL 400 ms, QRS 130 ms
Defining physiology: Atrial extrastimulus during SR, CI 370 ms

AV=220
HV=30
HV=40
Atrial extrastimulus during SR, CI 310 ms

AV = 225

HV = 40

HV = 10
Atrial extrastimulus during SR, CI 270 ms

AV=270

HV=0
Defining ventricular insertion: HV interval during tachycardia

HV = -5
Intermediate HV interval during fully preexcited QRS

HV = 40 ms

Josephson ME: Clinical Cardiac Electrophysiology. 2008 Lippincott Williams & Wilkins
Influence of retrograde RBBB

Josephson ME: Clinical Cardiac Electrophysiology. 2008 Lippincott Williams & Wilkins
Defining atrial insertion: atrial stimulation during tachycardia
Lateral atrial stimulation during tachycardia, PCL 360 ms
Septal atrial stimulation during tachycardia, PCL 360 ms
Atrial insertion: look for AP potential at lateral tricuspid annulus

I
II
V1
TA lat
TA lat
His d
His p
CS
CS
RV

AP pot
Defining tachycardia circuit: ventricular stimulation
Concealed AP with long conduction time: common features

- Location: posteroseptal
- Proximal insertion: A, Distal insertion: V
- Conduction time: long, usually decremental
- No antegrade conduction

Consequences:
- Normal ECG in SR
- Long RP narrow QRS tachycardia
- Tachycardia frequently incessant, easy to induce
- Demonstration of AP, theoretically easy by V extrastimuli with His refrac, limited by tachycardia irregularities and termination with stimulation
12-lead ECG during tachycardia
Defining presence of AP: V extrastimuli advances A w His refrac
Return cycle and S-A(St) vs S-A (tach) consistent with AP

Tach CL = 520
S-A (St) = 430
R C = 600
S-A (tach) = 400
Fibers are frequently narrow …
12-lead ECG
Ventricular pacing train during SR initiated tachycardia (50 mm/sec)
Ventricular pacing train during SR initiated tachycardia (100 mm/sec)
11-beat ventricular pacing train (CL 340) during tachycardia (CL 355 ms)
>30-beat ventricular pacing train (CL 340) during tachycardia (CL 355 ms)
What is the most likely mechanism of this tachycardia?

1) Atrial tachycardia
2) Orthodromic tachycardia (long conducting time accessory pathway)
3) AVNRT (slow-slow)
4) Uncommon AVNRT
5) Common AVNRT
A ventricular pacing train during SR initiates tachycardia. During the pacing train there are 2 QRS without atrial electrogram in between. What is the most likely mechanism of this phenomenon?

1) Retrograde dual AV nodal pathways
2) Retrograde Wenckebach
3) First few beats conducted through an AP and last beats conducted through specific conduction system
4) First few beats conducted through specific conduction system and last beats conducted through an AP
5) Catheter displacement
The observed response to a ventricular pacing train at a constant rate during tachycardia:

1) Has been described as typical of AVNRT
2) Has been described as typical of atrial tachycardia
3) Has been described as typical of orthodromic tachycardia (AP mediated)
4) Has been described as typical of ventricular tachycardia
4) Has not been described as typical of any arrhythmia
MEASUREMENTS AND ANSWERS
2 QRS without A in between: VA Wenckebach?
Measuring AA intervals
In summary, behavior during ventricular stimulation unlikely for VA Wenckebach:
1) VA unexpectedly short after block as compared to at initiation of pacing
2) VA after block decreases not increases
3) AA relatively constant after VA block
4) Hard to explain 2\textsuperscript{nd} A after last paced beat
Alternative explanation: 2 pathways for VA conduction with different VA conduction time
11-beat ventricular pacing train (CL 340) during tachycardia (CL 355 ms)

Note that tachycardia is not entrained: AA intervals remain as during tachycardia despite 11 ventricular beats at a CL 15 ms less than TCL: completely unexpected if ventricles are necessary: 11x15 = 165ms. QRS duration=130ms
>30-beat ventr. pacing train (CL 340) during tachycardia (TCL 365 ms): Tachycardia is entrained. Please note:

1) There is a VAAV response that has been described as typical for AT
2) Last entrained A is the 2nd after last paced V, and paced VA=470
3) This is a false VAAV response, for it to be true 1st A after last paced V should be the last entrained A
4) Return cycle (RC)=560 ms – TCL (360) = 200ms, correction for diff in AH (or AV) is only 15 ms, so corrected RC-TCL=185ms ⇒ AVNRT
5) Marked difference in paced VA (470) vs tach VA (260) favors AVNRT
As a summary of the findings:

1) The most likely mechanism is atypical AVNRT
   a. Response to pacing during tachycardia is inconsistent with an AP mediated SVT
   b. Apparent VAAV response should be re-interpreted
   c. SVT initiation suggests dual VA conduction

2) The response to V pacing for SVT initiation is not Wenckebach but jump from fast to slow retrograde AVN pathway or a 1 to 2 response

3) The observed response to V-pacing during SVT, although described for AT needs reinterpretation
The uncommon form of AV nodal reentry: common features

- Location: AV node, slow pathway at CS os
- Function: up the slow, down the fast
- Retrograde conduction time: long, always decremental

Consequences:
- Normal ECG in SR
- Long RP narrow QRS tachycardia
- Tachycardia frequently incessant, easy to induce
- AP cannot be demonstrated
- V extrastimuli modify the timing of A advancing the His
- S-A (stim) exceeds V-A (tach) by more than 110 ms
Parahisian pacing during tachycardia: change in VA depending upon QRS duration